Research Journal of Applied Sciences, Engineering and Technology 5(20): 4822-4826, 2013
DOI:10.19026/rjaset.5.4326
ISSN: 2040-7459; e-ISSN: 2040-7467

Submitted: August 24, 2012 Accepted: October 03, 2012 Published: May 15, 2013

Research Article

Providing a Comparative Method of Numbers Based on Ideal Positive and Negative Points and Use of an Appropriate Weight for Better diagnosis of Power

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Abstract: The set method of maximizing and minimizing is one of the favorite ranking methods for fuzzy numbers which ranks them on the basis of left and right regions or parts and general applications. This study shows an ordered method of ranking for Fuzzy numbers which define the new ordered region for the purpose of ranking and left and right regions within fuzzy numbers and improves two ideal points defined by means of an index with respect to the tendency of decision maker «DM» considering the risk–taking by an optimal weight and shows that the ranking method of combination by this weight has more differential and can improve the points method of ideal positive and negative which has used different values for (Alfa) by Wang *et al*. (2009) and with the help of an appropriate weight can improve that quality.

Keywords: Area ranking, L-R fuzzy number, maximizing and minimizing sets, normal fuzzy number, positive and negative ideal points, un-normal fuzzy number, weighted function

INTRODUCTION

Comparison of fuzzy numbers has been one of the most important issues in theory and application of fuzzy sets and different methods have been presented in present and past. Of these methods, the ranking method of maximizing and minimizing set proposed by Chen (1985) is a popular method. This simultaneously introduces a maximizing and minimizing set and ranks the fuzzy numbers concerning the left and right regions and those general applications. In the present study, points method of positive and negative optional was improved using the set method of maximized and minimized extremes as well as an appropriate weight in the mentioned method and that we have been able to rank the fuzzy numbers by set method of ideal positive and negative points which because of their identical general applications ranking them wasn't possible.

PRELIMINARIES

For the convenience of analysis, some basic concepts and definitions on fuzzy number are needed.

Definition 1: (Goetsch and Voxman, 1986). $\tilde{A}$ normal fuzzy number is a fuzzy set like μ: $\mathbb{R} \rightarrow I = [0,\ 1]$ which satisfies:

- $\mu$is upper semi – continuous
- $\mu(x) = 0$ Outside some interval [a, b]
- There are real numbers a such that$a \leq b \leq c \leq d$
  - $\mu(x)$is monotonic increasing on [a, b]
  - $\mu(x)$is monotonic decreasing on [c, b]
  - $\mu(x)$=1, b$\leq x \leq c$

The membership functionμcan be expressed as:

$$\mu_{\tilde{A}(x)} = \begin{cases} f_{L(x),}\ \mathrm{a} \leq x \leq b \\ 1, \mathrm{b} \leq x \leq c \\ f_{R(x)}, \mathrm{c} \leq x \leq d, \\ 0, \text{Otherwise} \end{cases} \quad (1)$$

where, $f_L: [a,b] \rightarrow [0,1]$and $f_R: [c,d] \rightarrow [0,1]$are left and right membership functions of fuzzy number μ. If b$\neq c$, $\tilde{A}$ is referred to as fuzzy interval or a flat fuzzy number. If $f_L and f_R$are both linear, then $\tilde{A}$ is referred toas a trapezoidal fuzzy number and is usually denoted by $\tilde{A} = (a,b,c,d)$, which is plotted in Fig. 1. In particular, when b = c the trapezoidal fuzzy number is reduced to a triangular fuzzy number denoted by $\tilde{A} = (a,b,d)$.

Definition 2: (Saneifard, 2009).$\tilde{A}$ is L – R fuzzy number $\tilde{A} = (m,n,\alpha,\beta)_{LR}$, m≤n and $\alpha,\beta \geq 0$, is defined as follows:

$$\mu_{\tilde{A}(x)} = \begin{cases} l\left(\frac{m-x}{\alpha}\right), & \text{if } -\infty < x < m \\ 1, & \text{if m} \leq x \leq n \\ \mathrm{R}\left(\frac{x-n}{\beta}\right), & \text{if n} < x < +\infty \end{cases} \quad (2)$$

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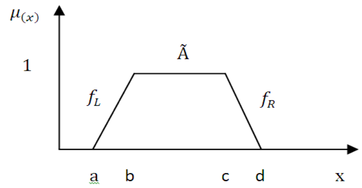

Fig. 1: Membership functions of trapezoidal fuzzy numbers

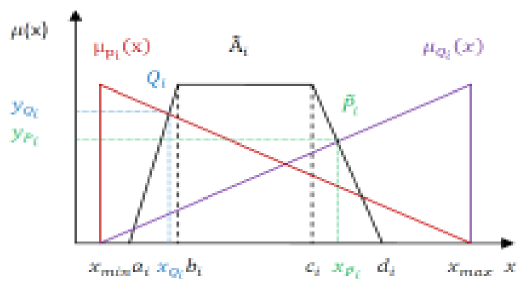

Fig. 2: Graphical representations of maximizing set and minimizing set

where α and β are the left – hand and the right- hand spreads, respectively. In the closed interval [m, n]. The membership function is equality (1). $L\left(\frac{m-x}{\alpha}\right)$ and $R\left(\frac{x-n}{\beta}\right)$ are non –increasing function with L (0) = 1 and R (0) = 1, respectively. For convenience, they are respectively, denoted as $\mu_{\tilde{A}^{l}(x)}$ and $\mu_{\tilde{A}^{R}(x)}$. It needs to point out that when L $(\frac{m-x}{\alpha})$ and $R\left(\frac{x-n}{\beta}\right)$ are linear functions and m<n, fuzzy number $\tilde{A}$ denoted trapezoidal fuzzy number. When $L(\frac{m-x}{\alpha})$ and $R\left(\frac{x-n}{\beta}\right)$ are linear functions and m=n, fuzzy number $\tilde{A}$ denotes triangular fuzzy number.

The maximizing set and minimizing set method: In the maximizing set and minimizing set method first defines a maximizing set P and $a$minimizing set$Q$, whose membership functions are respectively defined as (Chen, 1985):

$$\mu_{\tilde{P}(x)} = \begin{cases}[(x-x_{min})/(x_{max}-x_{min})]^n, x_{min} \le x \le x_{max}, \\ 0 \text{ Otherwise,}\end{cases} \quad (3)$$

$$\mu_{\tilde{Q}(x)} = \begin{cases}[(x_{max}-x)/(x_{max}-x_{min})]^n, x_{min} \le x \le x_{max}, \\ 0 \text{ Otherwise,}\end{cases} \quad (4)$$

where, $x_{max} = in\ fx, x_{max} = supx, x = \bigcup_{i=1}^{N} x_i,\ x_i = \{x \mid \mu_{\tilde{A}_i}(x) > 0\}$ and n is a constant reflecting the «DM's» attitude towards risks.

In Fig. 2, the maximizing set P and the minimizing set Q intersect the right and left membership functions of fuzzy number $\tilde{A}_i$ respectively at points P_i and Q_i. In the case that $\tilde{A}_i$ is a trapezoidal fuzzy number, i.e., $\tilde{A}_i = (a_i, b_i, c_i, d_i)$, the coordinates of $P_i$and $Q_i$can be determined by the following equations:

If h = $x_{max} - x_{min}$and $\forall$ i, $x_{max}= max\{a_i, d_i\}$, $x_{min}= min\{a_i, d_i\}$ then:

$$x_{\tilde{P}_i} = \frac{d_i x_{max} - c_i x_{min}}{(d_i - c_i) + h} \quad (5)$$

$$y_{\tilde{P}_i} = \frac{d_i - x_{min}}{(d_i - c_i) + h} \quad (6)$$

$$x_{\tilde{Q}_i} = \frac{b_i x_{max} - a_i x_{min}}{(b_i - a_i) + h} \quad (7)$$

$$y_{\tilde{Q}_i} = \frac{x_{max} - a_i}{(b_i - a_i) + h} \quad (8)$$

So, the final total utility value of the $\tilde{A}_i$ is defined as (Chen, 1985):

$$U_T(i) = \tfrac{1}{2}[y_{P_i} + 1 - y_{Q_i}],\ i = 1, \ldots, N \quad (9)$$

The greater the $U_T(i)$, the bigger the fuzzy number $\tilde{A}_i$ and the higher it's order.

Positive and negative ideal point's method: First, the positive and negative ideal points are respectively defined as$x_{max} = supx$and$x_{min} = infx$, where$x = \bigcup_{i=1}^{N} x_i$ and $x_i = \{x \mid \mu_{\tilde{A}_i}(x) > 0\}$ note that the positive and negative ideal points are crisp numbers. Let $\tilde{A}_i$ be one of the fuzzy numbers to be compared or ranked. The gaps between $\tilde{A}_i$ and the negative ideal point as well as the positive ideal point for two areas as shown in Fig. 3 and 4, which are referred to as the left and right areas respectively. The two are as normal fuzzy number is defined by the following equations:

$$S_{L(i)} = \int_{x_{min}}^{a_i} dx + \int_{a_i}^{b_i} \left(1 - f_{\tilde{A}}^{L}(x)\right) dx, \quad (10)$$

$$S_{R(i)} = \int_{c_i}^{d_i} \left(1 - f_{\tilde{A}}^{R}(x)\right) dx + \int_{d_i}^{x_{man}} dx, \quad (11)$$

In conformity with Ming and Luo (2009) and the de-normal fuzzy number two areas are defined by the following equations:

$(\tilde{A}_i = (a_i, b_i, c_i, d_i;\ k_i), 0< K_i < 1)$

$$S_{L(i)} = \int_{x_{min}}^{a_i} dx + \int_{a_i}^{b_i} \left(1 - f_{\tilde{A}_i}^{L}(x)\right) dx + bi(bi+ci)2\ (1-ki)dx \quad (12)$$

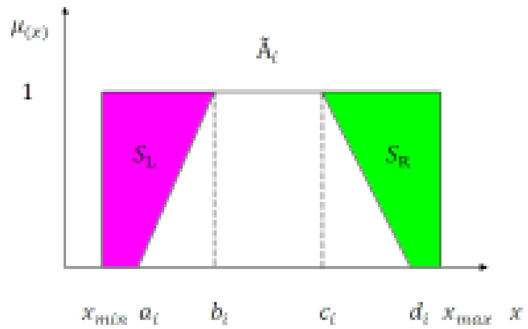

Fig. 3: Area ranking based on the positive and negative ideal points for un-normal fuzzy number (0≤m≤1)

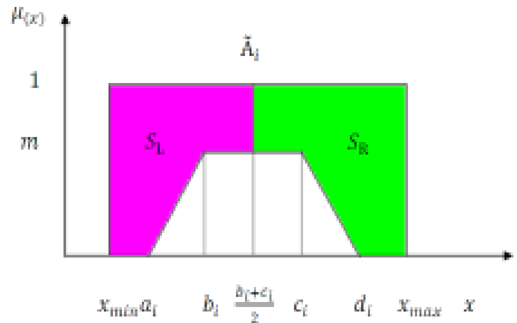

Fig. 4: Area ranking based on the positive and negative ideal points for un-normal fuzzy number (0≤*m*≤1)

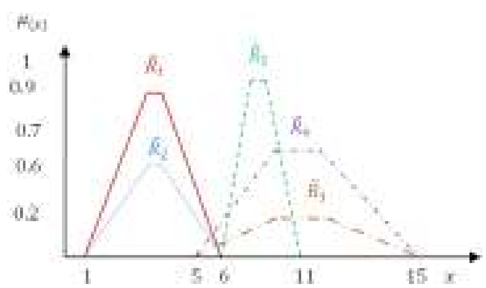

Fig. 5: Fuzzy numbers $\tilde{R}_1$, $\tilde{R}_2$, $\tilde{R}_3$, $\tilde{R}_4$ and $\tilde{R}_5$ in example 1

$$S_{R^{(i)}} = \int_{(b_i+c_i)/2}^{c_i} (1 - k_i)dx + \int_{c_i}^{d_i} \left(1 - f_{\tilde{A}_i}^{R}(x)\right) dx + dixmaxdx \quad (13)$$

Therefore, the index «DM's» risk based on areas negative and positive. The indexes «RIA» define by the following equation:

$$RIA(i) = \frac{1}{2}\left[\left(\frac{S_{L(i)}}{x_{max}-x_{min}}\right) r_L(i) + \left(1 - \frac{S_{R(i)}}{x_{max}-x_{min}}\right) r_{R^{(i)}}\right] \quad (14)$$

$$r_{L^{(i)}} = 1 + (\alpha - 0.5)\frac{b_i - a_i}{x_{max}-x_{min}} \quad (15)$$

Table 1: Ranking of rapezoidel fuzzy numbers R_1, R_2, R_3 , R_4 and R_5 in example 1

	$\tilde{R}_1$	$\tilde{R}_2$	$\tilde{R}_3$	$\tilde{R}_4$	$\tilde{R}_5$	Ranking
RIA (*i*)	0.107	0.116	0.331	0.311	0.264	$\tilde{R}_1 > \tilde{R}_2 > \tilde{R}_3 > \tilde{R}_4 > \tilde{R}_5$

$$r_{R^{(i)}} = 1 + (\alpha - 0.5)\frac{d_i - c_i}{x_{max}-x_{min}} \quad (16)$$

and $0 \leq \alpha \leq 1$; in which $r_{L^{(i)}}$ is a left risk factor and $r_{R^{(i)}}$ is a right risk factor**.** The index «RIA» is defined to be positive and measure, for base comparing and ranking fuzzy number, the bigger the index, the higher the fuzzy number in ranked.

The proposed ranking: In this method, we merge two methods of ranking maximizing set and minimizing set and the method of positive and negative ideal points. It means that in the method of positive and negative ideal points. It means that in the method of positive and negative ideal points instead of $r_{L^{(i)}}$ and $r_{R^{(i)}}$ in formula (14) we use a suitable weight, that the corresponding weight equal to the $U_{T^{(i)}}$ method of maximizing and minimizing set of formula (9) we consider:
In other words$r_{L^{(i)}}$=$U_{T^{(i)}}$ and $r_{R^{(i)}} = 1 - U_{T^{(i)}}$ so:

$$RIA(i) = \frac{1}{2}\left[\left(\frac{S_{L(i)}}{x_{max}-x_{min}}\right) U_{T^{(i)}} + \left(1 - \frac{S_{R(i)}}{x_{max}-x_{min}}\right)\left(1 - U_{T^{(i)}}\right)\right] \quad (17)$$

It changes follows. This new ranking index has more differentiate power index ranking has positive and negative ideal points. And this relation is applicable and used for fuzzy numbers. Just remember to both positive and negative ideal points for the fuzzy numbers that are being compared with the intended constant does not change.

Some numerical examples: In this section, several numerical examples are using to illustrate and show the efficiency of the ranking method.

Example 1: Consider five trapezoidal fuzzy numbers $\tilde{R}_1$ = (1, 3, 4, 6, 0.6), $\tilde{R}_2$= (1, 3, 4, 6, 0.9), $\tilde{R}_3$ = (5, 9, 12, 15; 0.2), $\tilde{R}_4$ = (5, 9, 12, 15; 0.7) and $\tilde{R}_5$ = (6, 8, 9, 11; 1) as shown Fig. 5, (Cheng, 1998; Chu and Tsao, 2002), these five fuzzy numbers cannot be ranked by the maximizing set and minimizing set method but by positive and negative ideal point to weight ranking in this study. The results are shown in Table 1.

Example 2: Consider the example investigated by Abbasbandy and Asady (2006); Wang *et al*., (2009), which contains three L–R fuzzy numbers $\tilde{R}_1 = (6, 6, 1, 1)_{LR}$, $\tilde{R}_2 = (6, 6, 0.1, 1)_{LR}$ and $\tilde{R}_3 = (6, 6, 0, 1)_{LR}$

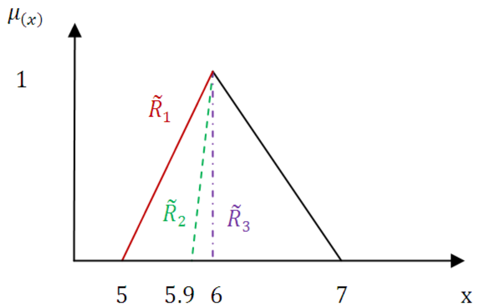

Fig. 6: Fuzzy numbers $\tilde{R}_1$, $\tilde{R}_2$ and $\tilde{R}_3$ in example 2

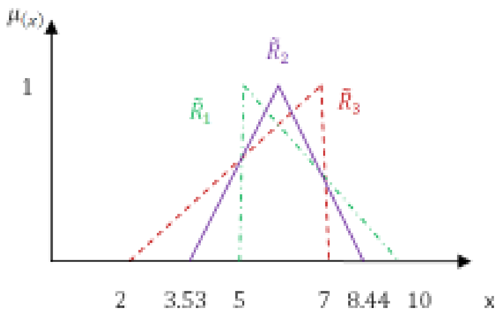

Fig.7: Fuzzy numbers $\tilde{R}_1$, $\tilde{R}_2$ and $\tilde{R}_3$ in example 3

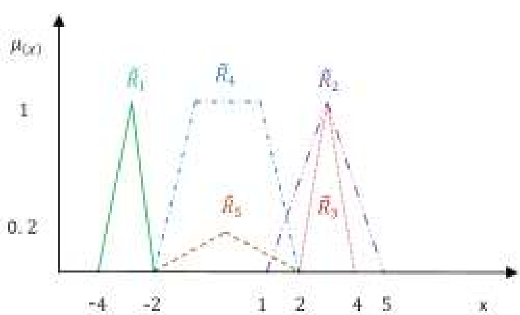

Fig. 8: Fuzzy numbers $\tilde{R}_1$, $\tilde{R}_2$, $\tilde{R}_3$, $\tilde{R}_4$ and $\tilde{R}_5$ in example 4

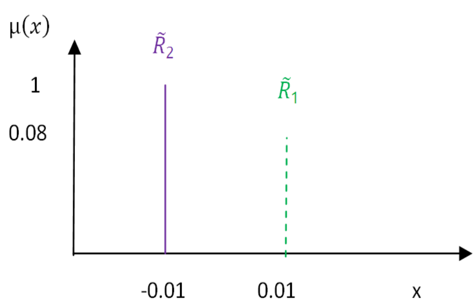

Fig. 9: Crisp numbers $\tilde{R}_1$ and $\tilde{R}_2$ in example 5

to be compared and ranked, as show in Fig. 6 and Table 2, gives the results obtained by the composing method has show $\tilde{R}_3 \succ \tilde{R}_2 \succ \tilde{R}_1$.

Table 2: Ranking of L-R fuzzy numbers R_1, R_2 and R_3 in example 2

	$\tilde{R}_1$	$\tilde{R}_2$	$\tilde{R}_3$	Ranking
RIA (i)	0.296	0.3021	0.250	$\tilde{R}_1 \succ \tilde{R}_2 \succ \tilde{R}_3$

Table 3: Ranking of triangular fuzzy numbers R_1, R_2 and R_3 in example 3

	$\tilde{R}_1$	$\tilde{R}_2$	$\tilde{R}_3$	Ranking
RIA (i)	0.2650	0.250	0.233	$\tilde{R}_1 \succ \tilde{R}_2 \succ \tilde{R}_3$

Table 4: Ranking of triangular fuzzy numbers R_1, R_2 R_3 , R_4 and R_5 in example 4

	$\tilde{R}_1$	$\tilde{R}_2$	$\tilde{R}_3$	$\tilde{R}_4$	$\tilde{R}_5$	Ranking
RIA (i)	0.075	0.363	0.375	0.230	0.223	$\tilde{R}_1 \succ \tilde{R}_2 \succ \tilde{R}_3 \succ \tilde{R}_4 \succ \tilde{R}_5$

Table 5: Ranking of crisp number R_1 and R_2 in example 5

	$\tilde{R}_1$	$\tilde{R}_2$	Ranking
RIA (i)	0.2	0.3	$\tilde{R}_1 \succ \tilde{R}_2$

Example 3: Consider three triangular fuzzy numbers taken from (Yao and Wu, 2000), $\tilde{R}_1$ = (5.06, 5.06, 10), $\tilde{R}_2$ = (3.53, 6, 8.47) and $\tilde{R}_3$ = (2, 6.94, 6.94), as shown in Fig. 7. These three fuzzy numbers are found to have equal left and right and total utilities and therefore cannot be ranking by the maximizing set and minimizing set method, but by the composing method have show where $\tilde{R}_1 \succ \tilde{R}_2 \succ \tilde{R}_3$. Therefore results are shown in Table 3.

Example 4: Consider five fuzzy numbers $\tilde{R}_1$ = (-4, -3, -2; 1) $\tilde{R}_2$ = (1, 3, 5; 1), $\tilde{R}_3$ = (2, 3, 4; 1), $\tilde{R}_4$ = (-2, -1, 1, 2; 1) and $\tilde{R}_5$ = (-2, 0, 2; 0.2) as shown Fig. 8 and Table 4. Gives the results obtained by the composing method have show:

$$\tilde{R}_3 \succ \tilde{R}_2 \succ \tilde{R}_4 \succ \tilde{R}_5 \succ \tilde{R}_1.$$

Example 5: Consider two crisp numbers $\tilde{R}_1$ = (-0.01, -0.01, -0.01, -0.01; 1) and $\tilde{R}_2$ (0.01, 0.01, 0.01, 0.01; 0.8), (Chen and Chen, 2003b), are shown in Fig. 9 and Table 5.

CONCLUSION

In this study we are complete by a suitable weight ranking method this new index composing tested by five example numbers. It has been shown that the proposed method ranking able to comparison and more ranking fuzzy numbers and has strong discrimination power as compared with some methods.

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